Silicon Photonics and its Applications in Life Science

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With the technology of silicon photonics gaining maturity there is a tendency to consider it as a generic technology that can serve a diverse range of markets, not only in datacom and telecom, but also in sensors, biosensors and biomedical instruments. The driver is always the same: create compact and low-cost integrated circuits with a functionality and performance at par with otherwise bulky and costly implementations. Examples of this trend include PIC's for sensing bioparticles such as proteins and DNA, PIC's for spectroscopic detection of various molecules (glucose, ammonia, markers for food spoilage etc), PIC's for optical coherence tomography or for laser Doppler vibrometry.

In those new applications the "traditional" wavelengths of silicon photonics (1.3 and 1.55 μm) are not necessarily optimal from the application's point of view. This has led to the recent trend to "translate" silicon photonics to other wavelength domains, as much as possible without shying away from its major asset which is to fabricate the chip in a CMOS fab. Many groups are pushing the frontiers of silicon photonics towards longer wavelengths (mid-infrared), mainly driven by the promise of using the technology for vibrational spectroscopy. In parallel other groups are pushing towards shorter wavelengths, so as to be more compatible with biological media, fluorescent markers and Raman spectroscopy. In this case the silicon core needs to be replaced by a material that is transparent in the visible, silicon nitride being a good candidate. In those applications silicon itself changes hat and becomes the near-perfect material for detection.

Below a bibliography is given of work the author has been involved in on the use of silicon and silicon nitride PICs in a life science context.

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